Poster P-B3-02

Decadal Prediction Research at the BSC

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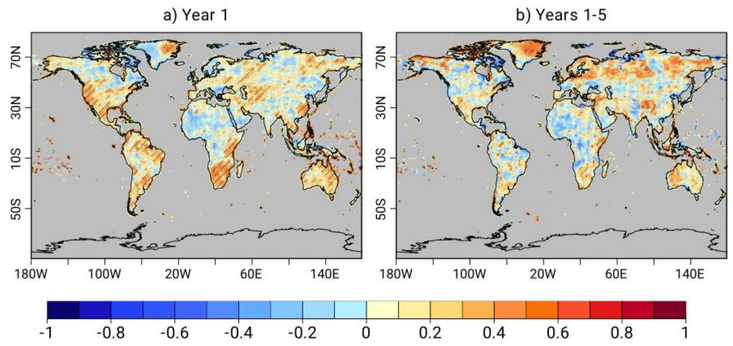
The EUCP Project

The **EUropean Climate Prediction system** project (EUCP) is a new EU Horizon 2020 project, which will develop an **innovative** European ensemble climate prediction system based on a new generation of improved, typically higher-resolution climate models, covering **timescales from seasons to decades** initialized with observations. The climate information provided by the system will be **co-designed with users** to support practical and strategic climate adaptation and mitigation decision-taking on local, national and global scales.

Development of an interannual-to-decadal Climate Forecast System

Objectives:

- Produce and collect decadal climate predictions
- Assess **forecast quality**
- Construct **probability forecasts** from multiple sources for specific applications
- Explore new avenues for the **improvement** of the decadal prediction systems



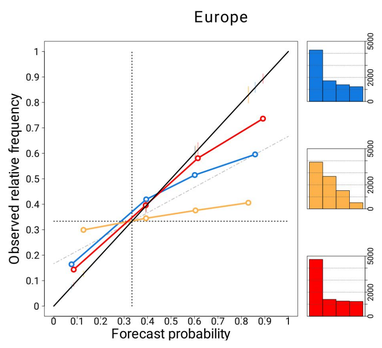


Fig. 1: Illustration of the forecast quality assessment using EC-Earth 2.3. Left: Anomaly correlation coefficients for precipitation, for a) forecast year 1 and b) average over forecast years 1 to 5. The forecasts are verified against GPCC v7. Hatched areas: statistically significant at the 5% level (taking into account the serial correlation of the time series). Right: anomaly reliability diagram for average forecast years 1-5 for the European region. Three events are represented: above-normal (red), normal (orange) and below-normal (blue). The sharpness diagrams (smaller panels) show the predicted frequencies for each event and probability range. The diagonal line indicates perfect reliability. The dot-dashed line represents the no-skill line. Consistency bars illustrate how likely the observed relative frequencies are under the assumption that predicted probabilities are reliable.

Towards a seamless near term European Climate Prediction System

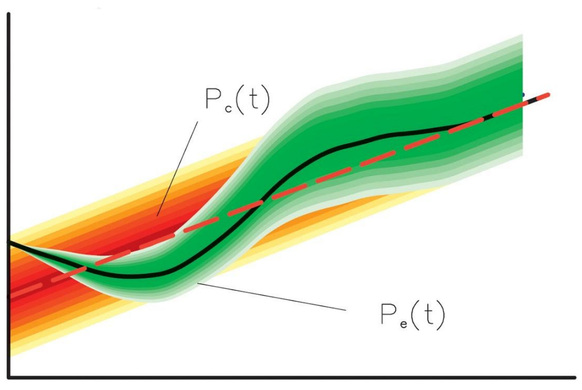


Fig. 2: From Branstator and Teng, 2010, J. Climate. Schematic of a time-evolving distribution under a changing external forcing. The red shadings indicate a probability density distribution of a No-INIT forced simulation (projection) over time, whereas the green shades illustrate the temporal evolution of an INIT forecast distribution of the same quantity.

Develop methodologies to **bring together initialised decadal climate predictions and non-initialised climate projections** based on global climate models, in order to provide **seamless climate information** for users over a period of 1 to 40 years into the future with a focus on the European region

- **Comparisons** of predictions: global **initialised** (INIT) **versus non-initialised** (No-INIT) simulations for common prediction time horizons. Estimation of the prediction time until which the INIT predictions show more **skill** than No-INIT simulations for different large-scale and local variables
- **Combination** of global INIT forecasts with No-INIT forced-only projections. Tests of the combining methods with a perfect model setting. Estimation of **added value** for combined predictions for different variables and regions.

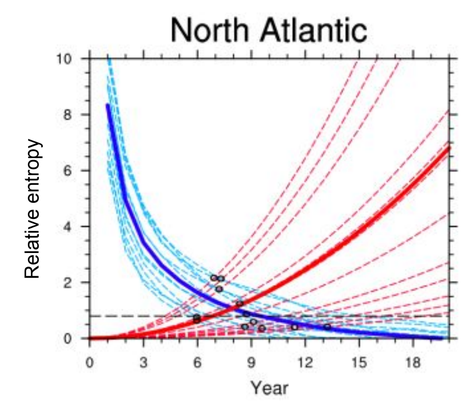


Fig. 3: From Branstator and Teng, 2012, GRL. The dashed lines show the relative entropy of ocean heat content as a function of forecast lead time for INIT (blue) and No-INIT (red) climate simulations from 12 individual CMIP5 models (dashed lines) and the mean of these models (thick solid lines).

User Engagement in Co-development

For creating effective climate services, a **co-development process** – a collective learning exercise, bringing together climate service providers and users – is indispensable. Stakeholders will be engaged and consulted regularly to guarantee reliable and quality-assured translation of climate prediction into actionable indicators and event triggers.

The project will establish a **multi-user forum** to provide feedback from actors in policy and practice. Validation of the service usability with different users will be an iterative exercise. A subset of highly proficient *Super-users* will help fine-tuning the service into products useful for and usable in decision-making.

To assure the lasting dialogue with stakeholders, we will organise thematic workshops, knowledge mapping exercises, policy briefings, and co-hosted panel discussions at different industry and policy events. Rather than being done in isolation, the user engagement activities will be conducted as a part of the **clustering activity** with European and international scientific communities.

Climate Change Adaptation and Mitigation

Assessing the **forecast quality** of **user-specific climatic indices** (e.g., drought index - Standardized Potential Evapotranspiration Index, SPEI).

Future work:

- Assessment of **multi-model** forecast quality
- Exploration of the relative improvement in using INIT and No-INIT simulations

For more details, see poster n° **P-B4-09** on Wednesday

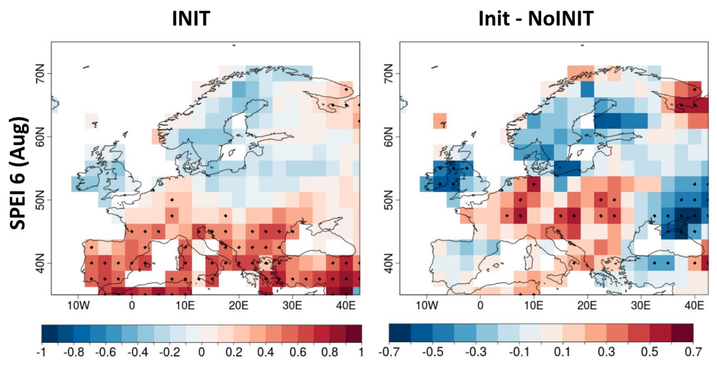


Fig. 4: Ensemble mean correlation map of the SPEI6 drought index (August) from the GFDL model averaged over the forecast years 2 to 5 (left: INIT prediction, right: difference between INIT and No-INIT simulation). Dotted region: statistically significant at 5% level.

Decadal Prediction of European Windstorms

Extra-tropical cyclones and associated Windstorms are the **most costly natural hazard** in Europe.

Within the EUCP project we will assess:

- **Quality of decadal predictions** of windstorms in a multi-model framework
- Effect of **spatial resolution** on decadal predictions of windstorms using the CGCM EC-Earth
- Role of the North Atlantic SST, especially the **AMV**, as source of decadal variability and predictability for decadal prediction of windstorms

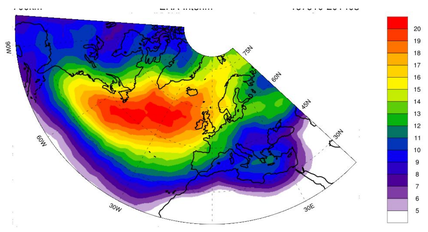


Fig. 5: Winstorm track density in events per winter (Oct-Mar) in ERA-Interim 1979-2014.

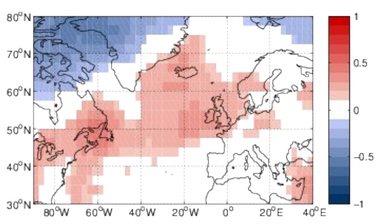


Fig. 6: Correlation between first PC of North Atlantic SST (HadISST1.1) and windstorm track density (ensemble mean of NOAA-20CRv2)

South America and the South Pacific Ocean

Analysis of the **impact of initialization** on the skill of the South Pacific Ocean Dipole (SPOD).
Future work in this area includes using these results to improve interannual-to-decadal predictions of **temperature** and **precipitation** over southern **South America** by means of the documented relationships that exist between variability of SST in the **South Pacific region** and those variables over the continent.

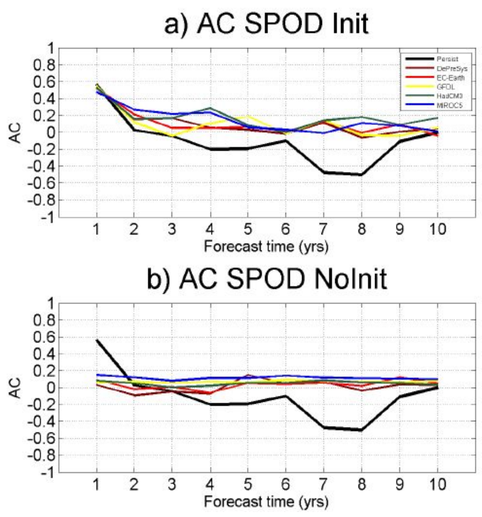


Fig. 7: Anomaly correlation of the SPOD for INIT (top) and No-INIT (bottom) simulations against the observed ERSST dataset. Each color stands for a different forecast system and the black thick line shows the anomaly correlation of a 1-year persisted prediction. There is a clear improvement in the predictions via initialization up to the third year.

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EUCP website: https://www.eucp-project.eu/

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